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Endohelminths of American Alligators (*Alligator mississippiensis*) from Southeast Texas

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ABSTRACT: Fifty American alligators (*Alligator mississippiensis*) were obtained from southeast Texas from September 1992 to September 1995. A total of 8,861 parasites were recovered from 46 infected alligators (92%). Necropsy revealed the presence of 1 species of pentastome (*Sebekia mississippiensis*), 3 species of nematodes (*Brevimulticaecum baylisi*, *B. tenuicolle*, and *Dujardinascaris waltoni*), and 8 species of trematodes (*Acanthostomum coronarium*, *A. loossi*, *A. pavidum*, *Archaeodiplostomum acetabulatum*, *Crocodilicola pseudostoma*, *Dracovermis occidentalis*, *Polycotyle ornata*, and *Pseudocrocodilicola georgiana*). Prevalence, mean intensity, and abundance of infection were higher in adult (≥1.80 m) alligators. There was no significant difference ($P > 0.05$) in mean intensity or abundance between male and female alligators. Infracommunity structure, based on species richness, intensity of infection, and diversity of endohelminths, is considered depauperate when compared to homeothermic hosts. However, alligator endohelminth communities are relatively rich and diverse compared to other reptilian hosts. Broadened feeding preferences, as related to maturity, are suggested as the main factor that determines endohelminth community structures in alligators.

KEY WORDS: alligator, endohelminths, population, abundance, intensity of infection, prevalence, pentastome, nematode, trematode, mature, immature.

The American alligator, *Alligator mississippiensis* Daudin, 1803, is a large crocodilian (1.8–5.0 m) that ranges throughout southeastern North America, from North Carolina, south through Florida, and west to central Texas. Parasitism among crocodilians is not well understood. Although there have been some investigations of parasites inhabiting the American alligator (*Alligator mississippiensis*), the majority of these studies have been taxonomic/systematic in nature (Byrd and Reiber, 1942; Brooks and Overstreet, 1977, 1978; Sprent, 1977, 1979; Deardorff and Overstreet, 1979; Overstreet et al., 1985). Only 2 endohelminth surveys of *A. mississippiensis* have been reported. Hazen et al. (1978) conducted the first survey on 12 alligators collected from 3 sites in South Carolina. Cherry and Ager (1982) performed a similar survey of 30 alligators from 7 counties in Florida. Although the Hazen et al. (1978) study contained far fewer host specimens, it is the most complete in terms of organ systems examined and parasite taxa recovered. There have been no scientific studies conducted on the prevalence of endohelminths in populations of Texas alligators and little inference about infracommunity structures in this host species. Herein, we provide information on endohelminths of a comparatively large sample of *A. mississippiensis* from southeastern Texas and use patterns of infection to describe the endohelminth infracommunity structure from the western portion of the host's geographic range.

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Material and Methods

Nine collections of alligator viscera ($n = 50$) were examined for endohelminths over a 3-yr period between 1992 and 1995. Alligators were recovered from Chambers, Jefferson, and Liberty counties in southeast Texas through the state-sanctioned hunting program or through a state-issued scientific collection permit (SPR-0992-562). Sex, length, and county of capture of the alligator were recorded. Alligators measuring at least 1.80 m were considered sexually mature (Taylor and Neal, 1984). Alimentary tract, respiratory system, liver, heart, and kidneys were removed (the esophagus, trachea, and anus were tied closed), and organs were individually placed in labeled plastic bags to ensure recovery of all helminths from their respective site of infection. All bags were placed in ice-filled coolers for transport to the laboratory. Viscera were frozen and stored at −10°C until they were examined utilizing a Nikon SMZ-U dissecting microscope. Helminth spe-

cies were identified using descriptions provided by Sprent (1977, 1979) for nematodes, Overstreet et al. (1985) for pentastomes, and Brooks and Overstreet (1977, 1978) and Byrd and Reiber (1942) for trematodes. No distinction was made between larval and mature helminths in this study. Voucher specimens of each species have been deposited with the United States National Parasite Collection, Beltsville, Maryland.

Nematodes, found only in the stomach, were rinsed with distilled water and placed in 70% EtOH. Temporary mounts of the worms were made utilizing lactophenol. Once cleared and identified and the sex determined, nematodes were placed in vials containing 70% EtOH. Some nematodes, after clearing, were mounted in Kleermount® according to methods described in Ash and Orihel (1991). Although this technique is not usually recommended for the mounting of nematodes, distortion was not apparent and results were satisfactory for some smaller nematodes. Pentastomes from the lungs, pleural sacs, and bronchioles of alligators were rinsed with distilled water and placed in a solution of 70% EtOH and 5% glycerin for storage. Trematodes were recovered from the intestinal tract, rinsed with distilled water, and placed in 70% EtOH. Worms were then fixed in AFA and stained with Semichon's acetocarmine stain. Staining was normally halted after 10–15 min by removing excess stain from the vials and rinsing the worms with 70% EtOH. Destaining, when necessary, was accomplished by utilizing 2% acid alcohol. Trematodes were then dehydrated through an alcohol gradient to 100%, cleared in methyl salicylate, and mounted in Kleermount®.

A nonparametric 2-tailed Welch's approximate *t*-test (Ott, 1988) was chosen to analyze the difference between abundance and mean intensity of infections of immature and mature alligators and between male and female alligators. This nonparametric *t*-test was chosen because variances between the 2 groups analyzed were significantly different. Species richness was used to describe infracommunity structure. Species richness was compared between male and female alligators, as well as between immature and mature alligators, using a Student's *t*-test (Ott, 1988). Species richness, abundance, and mean intensity were also compared between alligators in this study and alligators censused from South Carolina (Hazen et al., 1978) using a nonparametric Welch's approximate *t*-test. Brillouin's index (Pielou, 1975) was used to provide a measure of infracommunity diversity. The Student's *t*-test was used to compare diversity indices between male and female, as well as between immature and mature Texas alligators. Similarly, the Student's *t*-test was used to compare the diversity of censused Texas alligators, as measured by Brillouin's index, to the diversity of censused South Carolina alligators (Hazen et al., 1978). Use of ecological terms follow suggestions of Margolis et al. (1982).

Results and Discussion

Twelve species of helminths were collected from 50 American alligators, 4 of which were free of helminths. Parasites recovered included 3 species of nematodes, 1 pentastome species, and 8 species of trematodes. All are known from American alligators. Prevalence, abundance, and mean intensities of each species are given in Table 1. Individual alligators harbored between 0 and 9 species of helminths. Eight percent of the alligators examined were found free of helminths. Alligators with more than 5 species were rare (15.2%), with 84.8% of infected hosts harboring 1–5 species of helminths. Infections were as follows: 2 alligators had only 1 helminth species, 7 alligators had 2 species, 11 alligators had 3 species, 10 alligators had 4 species, 9 alligators had 5 species, 4 alligators had 6 species, 1 alligator had 7 species, 1 alligator had 8 species, and 1 alligator had 9 species. A total of 8,861 helminths were collected. The number of worms recovered from infected hosts ranged from 1 to 1,241 (average 192.63 ± 277.68).

Abundance and mean intensities of infections for male and female alligators were examined overall and by individual helminth species. Results from Welch's approximate *t*-test indicate no significant differences ($P > 0.05$) in abundance or mean intensity of infection between male alligators and female alligators.

Three different species of nematodes were found in the stomach of alligators: *Brevimulticaecum baylisi* Travassos, 1933, *Brevimulticaecum tenuicolle* Rudolphi, 1819, and *Dujardinascaris waltoni* Sprent, 1977. Nematodes were found in both immature (<1.80 m) and mature (≥1.80 m) alligators. Unique to the nematodes, the prevalence of infection was highest (64%) among immature alligators (Table 1). Mature alligators possessed a slightly lower prevalence of infection (60%) (Table 1). Mean intensities and abundance of individual nematode species were not significantly different ($P > 0.05$) when compared between mature and immature alligators.

Pentastomes (*Sebekia mississippiensis* Overstreet, Self, and Vliet, 1985) were also recovered from the lungs, pleural sacs, and bronchioles of immature and mature alligators, with the highest prevalence (72%) in mature alligators (Table 1). No significant difference ($P > 0.05$) in mean intensity of pentastome infection was observed between immature and mature alligators. Due to the higher prevalence, however, the abundance of *S. mississippiensis* in mature alligators was significantly higher ($P < 0.05$) than in immature alligators.

Mature alligators possessed a greater preva-

Table 1. Parasites recovered from immature and mature *A. mississippiensis* from Texas.*

Parasite	Immature				Mature			
	Prevalence	MI ± SD	Range	A ± SD	Prevalence	MI ± SD	Range	A ± SD
Nematoda	**64% (16/25)**	**14.2 ± 18.3**	**1–63**	**9.1 ± 16.0**	**60% (15/25)**	**59.5 ± 113.1**	**2–453**	**35.7 ± 91.3**
Brevimulticaecum baylisi (USNPC 86186)	40% (10/25)	5.6 ± 5.9	1–16	2.2 ± 4.6	16% (4/25)	1.8 ± 1.0	1–3	0.3 ± 0.7
Brevimulticaecum tenuicolle (USNPC 86187)	44% (11/25)	6.6 ± 7.1	1–22	2.9 ± 5.7	8% (2/25)	12.0 ± 14.1	2–22	1.0 ± 4.4
Dujardinascaris waltoni (USNPC 86188)	44% (11/25)	8.9 ± 11.0	1–33	3.9 ± 8.4	56% (14/25)	61.6 ± 117.1	1–453	34.5 ± 91.6
Pentastomida								
Sebekia mississippiensis (USNPC 86189)	12% (3/25)	3.0 ± 2.7	1–6	0.4 ± 1.3	72% (18/25)	2.3 ± 1.2	1–5	1.7 ± 1.5
Trematoda	**56% (14/25)**	**70.1 ± 90.0**	**3–318**	**39.2 ± 75.1**	**100% (25/25)**	**268.4 ± 325.8**	**2–1,240**	**268.4 ± 325.8**
Acanthostomum coronarium (USNPC 86178)	16% (4/25)	37.0 ± 33.7	1–78	5.9 ± 18.3	32% (8/25)	12.4 ± 15.1	1–47	4.0 ± 10.1
Acanthostomum loossi (USNPC 86179)	04% (1/25)	3.0	—	0.1 ± 0.2	24% (6/25)	201.3 ± 447.0	2–1,113	48.3 ± 222.1
Acanthostomum pavidum (USNPC 86180)	08% (2/25)	8.0 ± 5.7	4–12	0.6 ± 2.5	56% (14/25)	29.7 ± 62.7	1–242	16.6 ± 48.5
Archaeodiplostomum acetabulatum (USNPC 86181)	—	—	—	—	4% (1/25)	5.0	—	0.2 ± 1.0
Crocodilicola pseudostoma (USNPC 86182)	—	—	—	—	4% (1/25)	2.0	—	0.1 ± 0.4
Dracovermis occidentalis (USNPC 86183)	8% (2/25)	3.5 ± 3.5	1–6	0.3 ± 1.2	60% (15/25)	123.2 ± 165.3	9–622	73.9 ± 140.5
Polycotyle ornata (USNPC 86184)	36% (9/25)	8.4 ± 9.5	1–32	3.0 ± 6.9	52% (13/25)	11.5 ± 21.7	1–32	6.0 ± 16.4
Pseudocrocodilicola georgiana (USNPC 86185)	56% (14/25)	52.2 ± 86.1	1–312	29.2 ± 68.7	76% (19/25)	157.0 ± 241.4	2–786	119.3 ± 220.2
Total parasites	84% (21/25)	58.0 ± 92.7	1–371	48.7 ± 87.3	100% (25/25)	305.8 ± 329.0	17–1,241	305.8 ± 329.0

* Abbreviations: USNPC = United States National Parasite Collection, MI = mean intensity, A = abundance.

lence of trematode infections than immature alligators, 100 and 56%, respectively (Table 1). All trematodes recovered were found within the intestine of their hosts. *Pseudocrocodilicola georgiana* Byrd and Reiber, 1942, was the most prevalent trematode in this study (Table 1); however, in mature alligators, the mean intensity of *P. georgiana* (157) was less than that of *Acanthostomum loossi* Perez Viguera, 1957 (201) (Table 1). *Crocodilicola pseudostoma* Willemoes-Suhm, 1870, and *Archaeodiplostomum acetabulatum* Dubois, 1944, were found only in mature alligators, and both were extremely rare (Table 1). Four other trematodes also were recovered, including *Acanthostomum coronarium* Cobbold, 1861, *Acanthostomum pavidum* Brooks and Overstreet, 1977, *Dracovermis occidentalis* Brooks and Overstreet, 1978, and *Polycotyle ornata* Willemoes-Suhm, 1870.

The abundance and mean intensity of trematodes in immature alligators and mature alligators (Table 1) were significantly different ($P < 0.05$). Specific analyses of the abundance and mean intensities of individual trematode species revealed that *D. occidentalis* was significantly greater in mature alligators ($P < 0.05$). No other trematode species were found to be significantly different ($P > 0.05$) between immature and mature alligators.

The mean species richness was 3.6 ± 2.0 for each host analyzed. Examination of males and females revealed no significant difference ($P > 0.05$) in species richness. However, mature Texas alligators possessed a species richness of 4.60 ± 1.76, which was significantly different ($P < 0.05$) from that of immature alligators (2.68 ± 1.70).

Brillouin's index ranged from 0.04 to 1.31, with a mean value of 0.54 ± 0.37. Additionally, there was no significant difference ($P > 0.05$) found between the Brillouin's indices of immature and mature Texas alligators. Brillouin's indices were compared between males and females of Texas alligators and were not found to be significantly different ($P > 0.05$).

Helminth community structure from the southwestern portion of the alligator's range is similar to that reported by Hazen et al. (1978) in an endohelminth study on alligators from South Carolina. Texas alligators possessed more helminth species (12) than those of South Carolina (7), but the South Carolina alligators had significantly higher ($P < 0.05$) mean intensities (589.25 ± 482.52) than Texas alligators (192.63 ± 277.68). Additionally, abundance was also significantly higher ($P < 0.05$) in South Carolina alligators (589.25 ± 482.52) than in Texas alligators (177.22 ± 271.29). The species richness from alligators examined in South Carolina (Hazen et al., 1978) was 3.92 ± 0.79 and was not significantly different ($P > 0.05$) from southeast Texas (3.60 ± 2.00). The Brillouin's index for helminths of alligators from South Carolina (Hazen et al., 1978) was also calculated (0.56 ± 0.35) and was found not to be significantly different ($P > 0.05$) from the Brillouin's index calculated for Texas alligators (0.54 ± 0.37).

Texas alligators tended to have a wider diversity of endohelminths than South Carolina alligators, but the South Carolina alligators had heavier infections. Sample size, different habitats, temperatures, and prey items may likely play a role in the endohelminth differences noted between alligators from South Carolina and Texas.

Highly variable helminth communities of this study and the Hazen et al. (1978) study correlate strongly with parasite communities of other reptiles (Aho, 1990). Although alligator helminth communities are comparatively depauperate when compared to helminth communities of homeothermic hosts, they are relatively rich when compared to other reptiles (Aho, 1990).

The prey taken by alligators generally appears to be determined by alligator size, as well as by its availability in the habitat. The size of the alligator has been shown to be positively correlated with the size of its prey (McNease and Joanen, 1977; Delany and Abercrombie, 1986; Wolf et al., 1987). It was also observed through this study, as well as through the study conducted in South Carolina (Hazen et al., 1978), that species richness, abundance, mean intensity of infection, and diversity increased as alligator size increased. Therefore, it is suggested that the broadening of general feeding preferences, as related to maturity, is a significant factor that determines infracommunity structure of alligator helminths.

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Literature Cited

Aho, J. M. 1990. Helminth communities of amphibians and reptiles: comparative approaches to understanding patterns and processes. Pages 157–195 *in* G. W. Esch, A. O. Bush, and J. M. Aho, eds. Parasite Communities: Patterns and Processes. Chapman and Hall, New York.

Ash, L. R., and T. C. Orihel. 1991. Parasites: A Guide to Laboratory Procedures and Identification. American Society of Clinical Pathologists Press, Chicago. 328 pp.

Brooks, D. R., and R. M. Overstreet. 1977. Acanthostome digeneans from the American alligator in the southeastern United States. Proceedings of the Biological Society of Washington 90:1016–1029.

———, and ———. 1978. The family Liolopidae (Digenea) including a new genus and two new species from crocodilians. International Journal for Parasitology 8:267–274.

Byrd, E. E., and R. J. Reiber. 1942. Strigeid trematodes of the alligator, with remarks on the prostate and terminal portions of the genital ducts. Journal of Parasitology 28:51–73.

Cherry, R. H., and A. L. Ager. 1982. Parasites of American alligators (*Alligator mississippiensis*) in south Florida. Journal of Parasitology 68:509–510.

Deardorff, T. L., and R. M. Overstreet. 1979. *Goezia lacerticola* sp. n. (Nematoda: Anisakidae) in *Alligator mississippiensis* from Florida. Journal of Helminthology 53:317–320.

Delany, M. F., and C. L. Abercrombie. 1986. American alligator food habits in northcentral Florida. Journal of Wildlife Management 50:348–353.

Hazen, T. C., J. M. Aho, T. M. Murphy, G. W. Esch, and T. D. Schmidt. 1978. The parasite fauna of the American alligator (*Alligator mississippiensis*) in South Carolina. Journal of Wildlife Diseases 4:435–439.

Margolis, L., G. W. Esch, J. C. Holmes, A. M. Kuris, and G. A. Schad. 1982. The use of ecological terms in parasitology (report of an *ad hoc* committee of the American Society of Parasitologists). Journal of Parasitology 68:131–133.

McNease, L., and T. Joanen. 1977. Alligator diets in relation to marsh salinity. Proceedings of the Annual Conference of Southeastern Association of Fish and Wildlife Agencies 31:36–40.

Ott, L. 1988. An Introduction to Statistical Methods and Data Analysis. PWS-Kent Publishing, Boston. 835 pp.

Overstreet, R. M., J. T. Self, and K. A. Vliet. 1985. The pentastomid *Sebekia mississippiensis* sp. n. in the American alligator and other hosts. Proceedings of the Helminthological Society of Washington 52:266–277.

Pielou, E. C. 1975. Ecological Diversity. Wiley-Interscience, New York. 165 pp.

Sprent, J. F. A. 1977. Ascaridoid nematodes of amphibians and reptiles: *Dujardinascaris*. Journal of Helminthology 51:251–285.

———. 1979. Ascaridoid nematodes of amphibians and reptiles: *Multicaecum* and *Brevimulticaecum*. Journal of Helminthology 53:91–116.

Taylor, D., and W. Neal. 1984. Management implications of size class frequency distributions in Louisiana alligator populations. Wildlife Society Bulletin 12:312–319.

Wolfe, J. L., D. K. Bradshaw, and R. H. Chabreck. 1987. Alligator feeding habits: new data and a review. Northeast Gulf Science 9:1–8.